ONHYM
المكتب الوطني للهيدروكاربورات و المعادن
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES

HYNAT
NATURAL HYDROGEN

COLLABORATIVE WORK FOR H2 EXPLORATION IN THE SOUTHERN PROVINCES OF MOROCCO

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ONHYM : NATURAL HYDROGEN EXPLORATION

- **ONHYM : State organization with legal personality, financial autonomy and Governmental control**
- **Created on 2005 by the merger of :**
  - **BRPM (1928)**
  - **ONAREP (1981)**

- **ONHYM is in charge of research and development of Mines and Hydrocarbons potential of Morocco**
- **ONHYM launched the renewable energy projects:**
  - **2012 – geothermal**
  - **2017 – Natural H_2**

- **Moroccan strategy of diversification of energy sources**
- **ONHYM natural hydrogen projects are particularly promising**
- **The objectives:**
  - Carrying out an assessment of the natural hydrogen potentialities in the Kingdom;
  - Targeting promising areas;
  - Conducting the detailed works on the defined targets
  - Exploiting this resources and participate to energetic mix growth

HISTORY OF NATURAL H_2 RESEARCH IN MOROCCO

2017 ONHYM has carried out a preliminary assessment on Moroccan potentialities in natural Hydrogen

2019 ONHYM has launched a support and international expertise in the research of natural hydrogen in Morocco

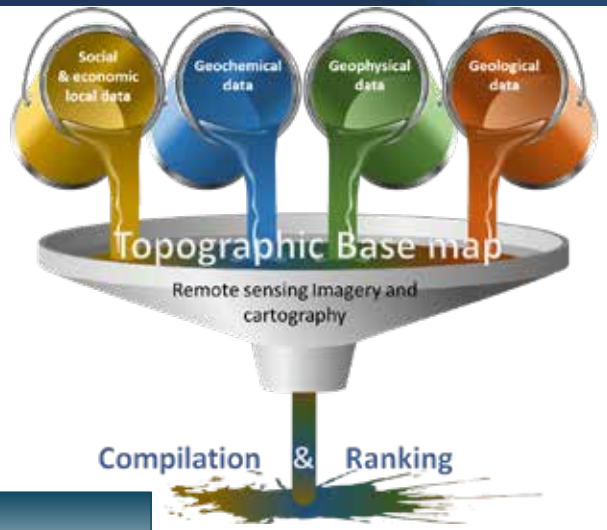
2021 ONHYM and HYNAT have signed a memorandum of understanding for the development of natural H_2 potentialities in the Southern Provinces of Morocco

2023 ONHYM continues to develop in partnership all targets highlighted

2024

- ONHYM signed a MOU for the development of natural H_2 potentialities with UM6P
- ONHYM signed a MOU for the development of natural H_2 potentialities with STORENGY

FIRST ASSESSMENT OF NATURAL H_2 POTENTIAL IN MOROCCO



1- Pre-screening

i) geological settings
ii) data compilation
iii) pre-screened areas

2- Screening

iv) satellite & remote sense imagery
v) GIS
vi) Selected areas

3- Ranking

vii) Ranking qualification

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TARGET RANKING

Criteria
Density and size of geomorphic depressions
Land ownership
Anthropogenic activities
Accessibility
Land use
Access to data on local geology
Distance to industrialised areas

Coastal Meseta

- Largest density of geomorphic depressions
- Accessibility is excellent
- Many groundwater wells and quarries
- Proximity Casablanca, Mohammedia ,Rabat
- Intensive agriculture and human activities

Southern coastal Basins

- Large size structures - dayas and sebkhas
- Several small depressions
- Accessibility acceptable and no human disturbance.
- Oil exploration boreholes and groundwater wells
- Vegetation scarce ,no flooding problems.
- poorly industrialised.

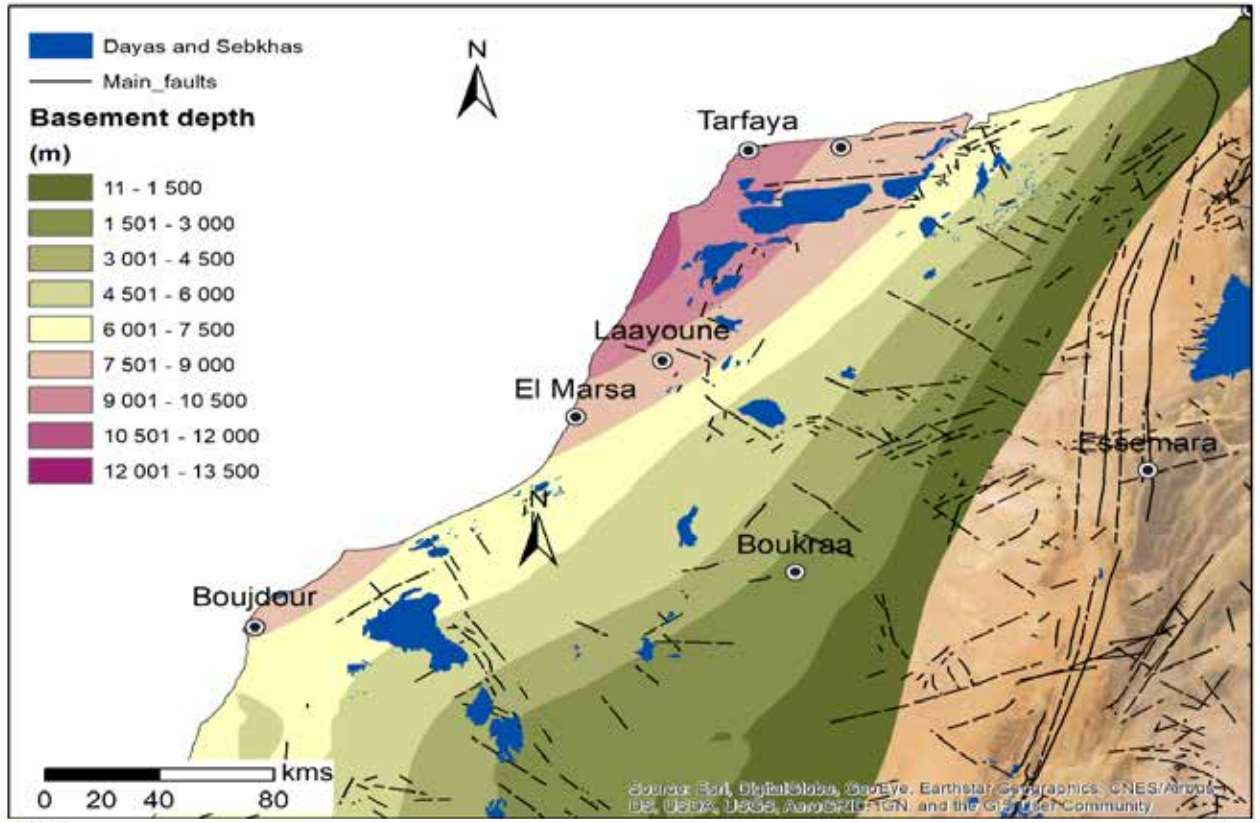
Khemisset Basin

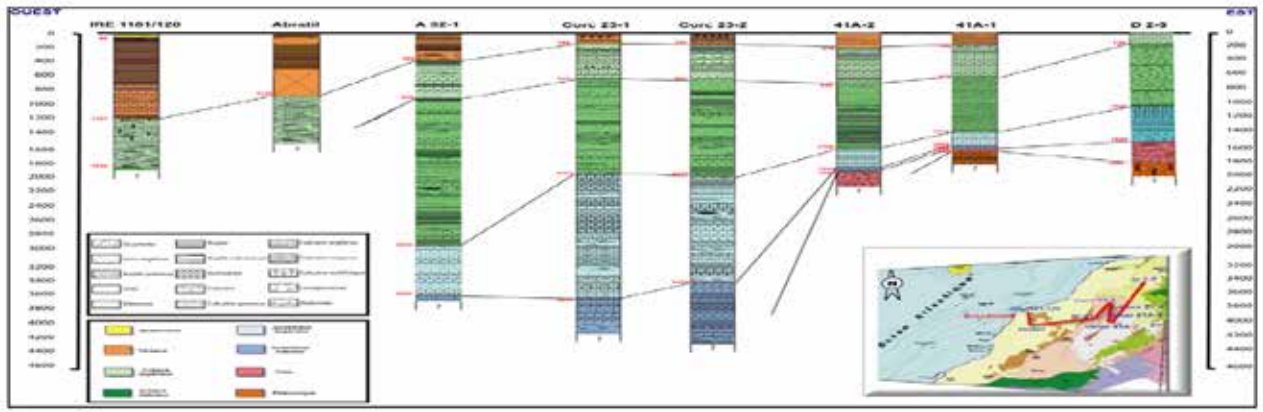
- Deep boreholes for potash exploration
- Some geomorphic structures
- Geologic conditions well known
- Accessibilities are very good
- Investments in industrial development
- Plans for large potash mine is planned

Reguibat Shield

- Several *dayas* and *sebkhas*
- Human occupation is scarce
- Aridity of the area
- Accessibilities are poor
- Absence of industry

GEOLOGICAL AND STRUCTURAL CONTROLS





EQUIPEMENTS

Portable Hydrogen Analyzer

Drill and Probe

terra Spec halo Spectroradiometer

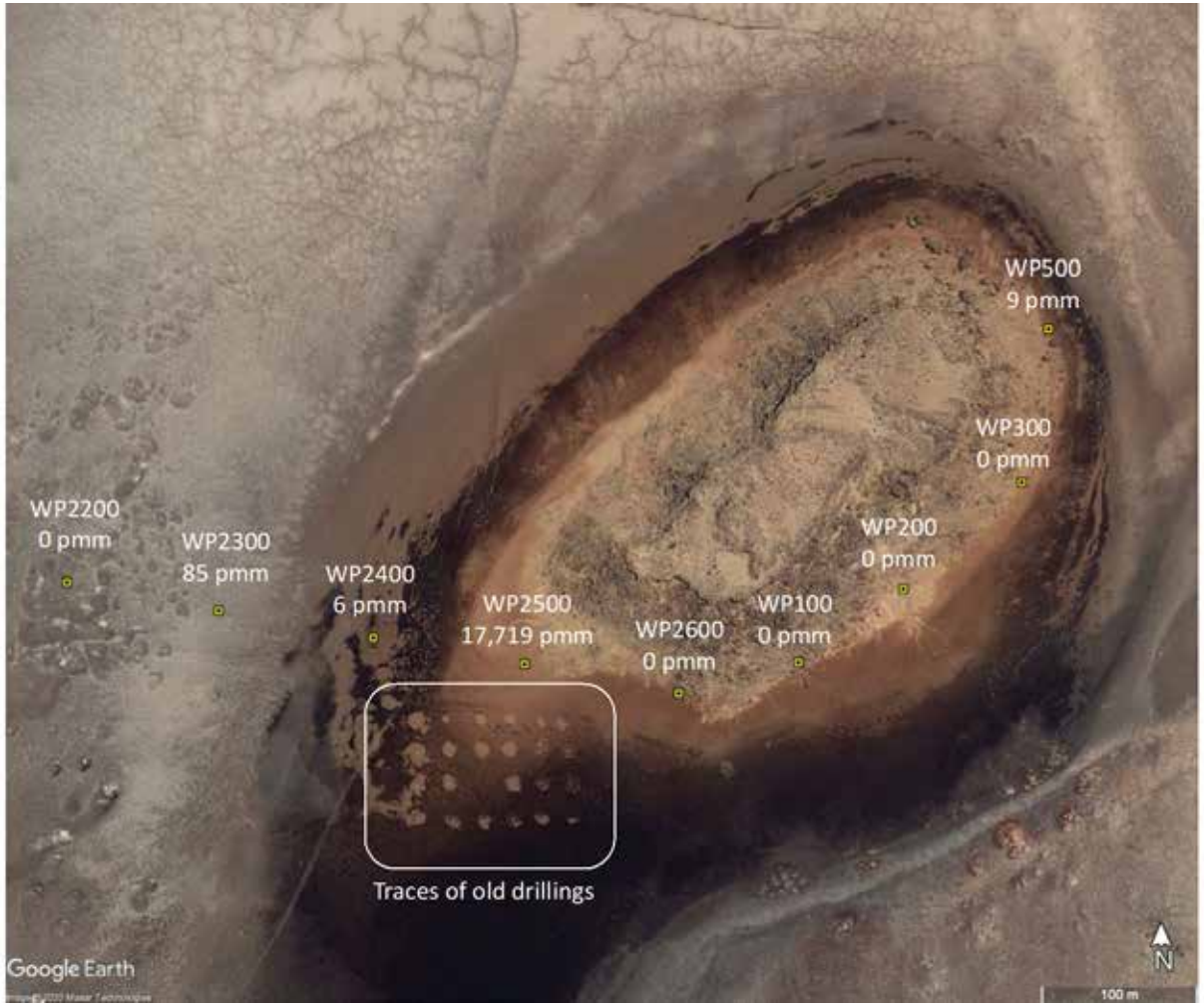
XRF Analyser

Gamma ray

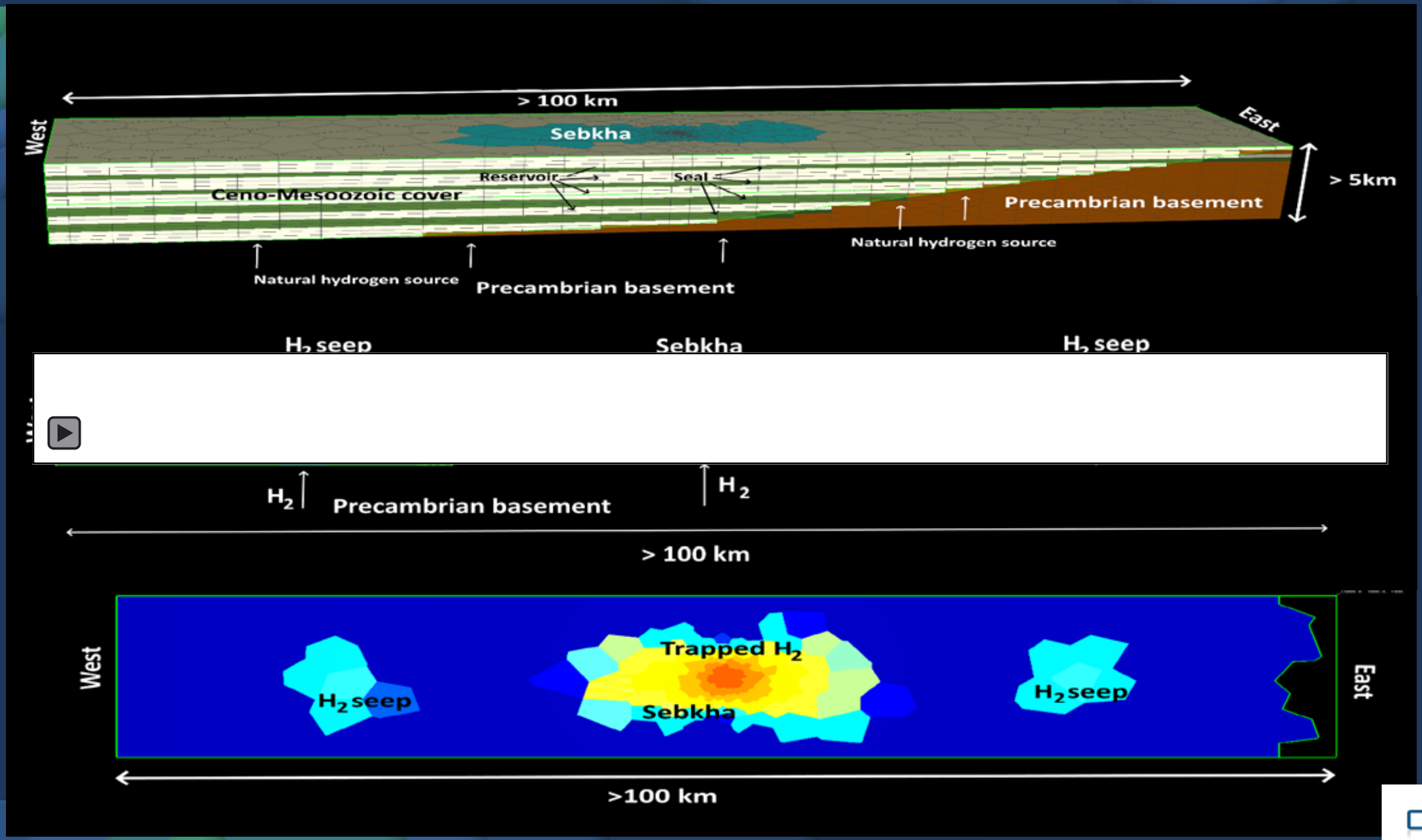
SOIL GAS MEASUREMENTS

Sample	He (ppm)	H_2 (ppm)	O_2 (%)	N_2 (%)	CH_4 (ppm)	CO (ppm)	CO_2 (%)
Camp, 20m	5	226	20.52	77.96	3.9	12	0.12
Gara, 2500	3.9	7363	19.3	79.36	234	36	0.34

Elongated from North to South and is approximately 17 x 6 km in size, west from Daoura.
Three measurement locations
1) near a camping site- three locations (H_2 from 10 ppm to 181 ppm)
2) along a transect NW to SE and around Gara Mount (H_2 one location 17719 ppm, δD is -778 +/-5)
3) around a hill inside the sebkha (no H_2)



CONCEPTUAL MODEL – TARFAYA AREA



SOIL GAS MESUREMENTS

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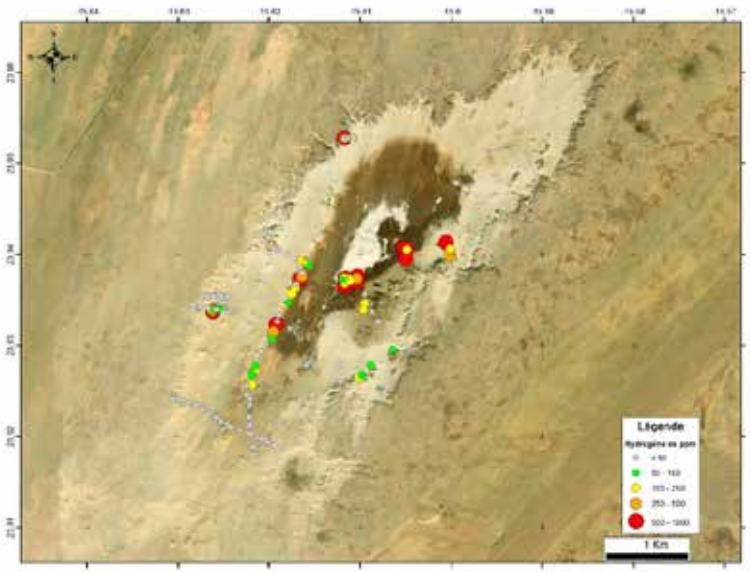
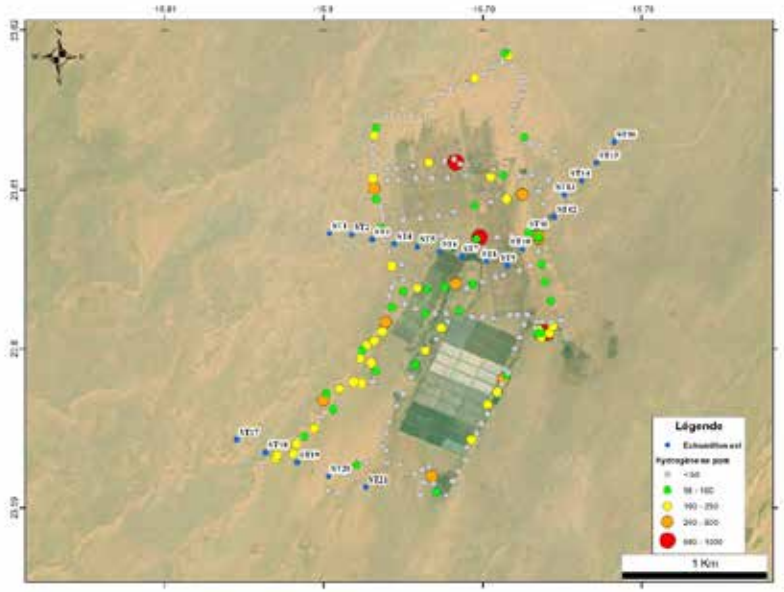
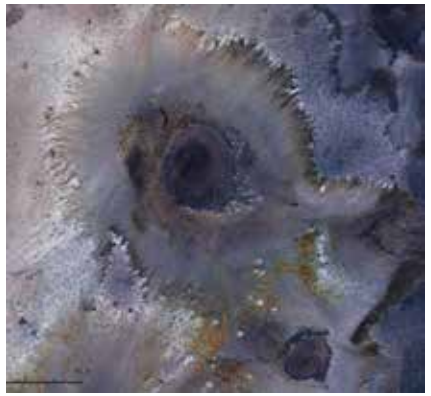
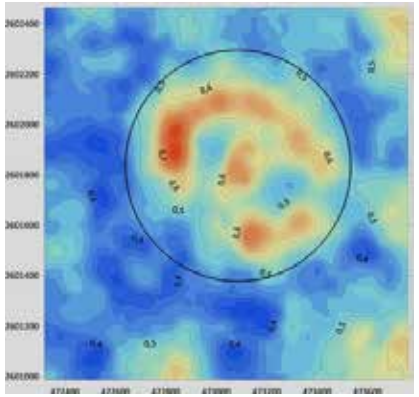




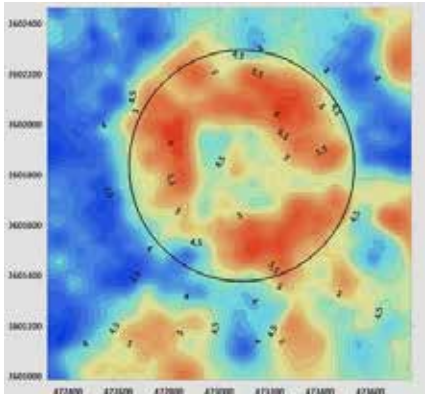
- **Majority of inventoried structures show natural Hydrogen seepage.**
- **The flow rate of the free gas is sometimes very important exceeding 0.1%.V (saturation value of GA5000)**

GAMMA RAY SPECTROMETRY

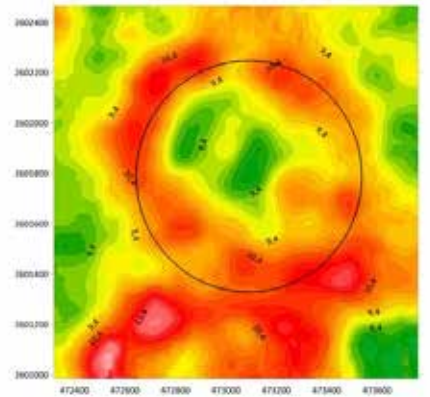




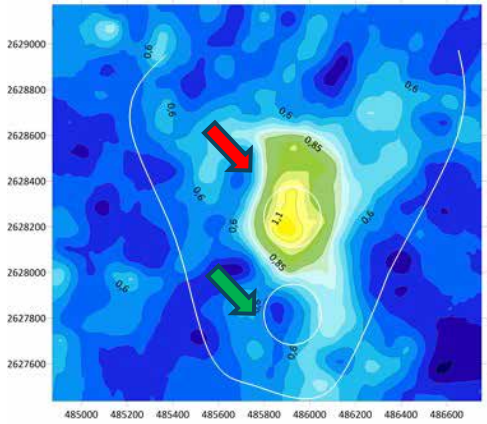
K max/min = 4,2



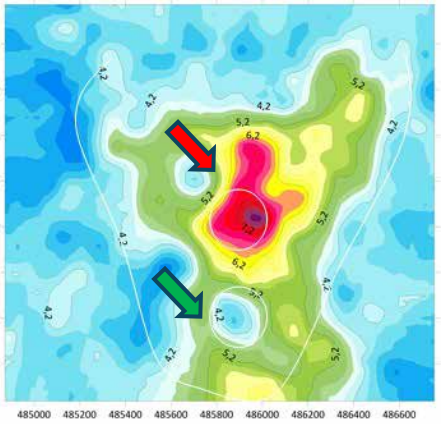
Th max/min = 3,7



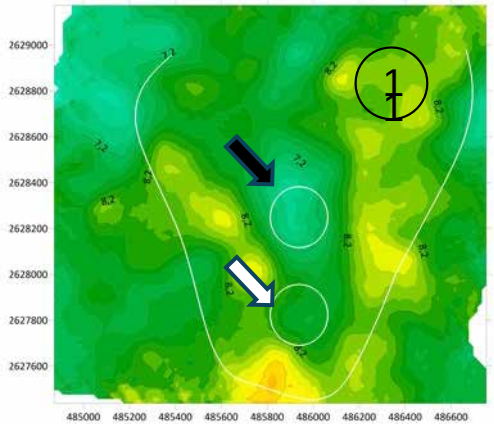
Th/k max/min = 4, 2



K max/min = 6,0



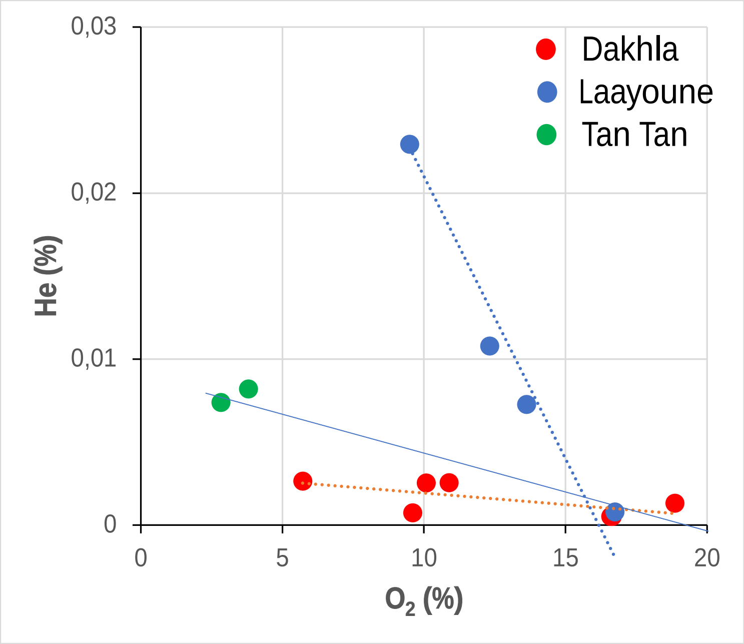
Th max/min = 4,5

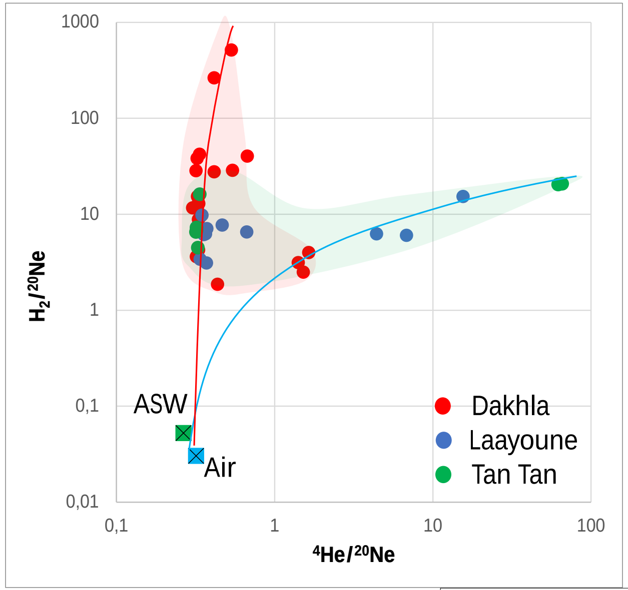


Th/k max/min = 5,3

CHEMICAL ANALYSIS

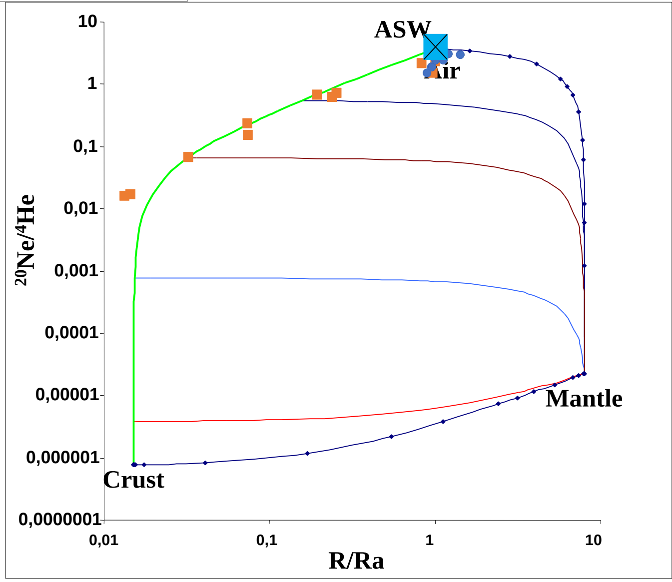
Helium and oxygen measurements



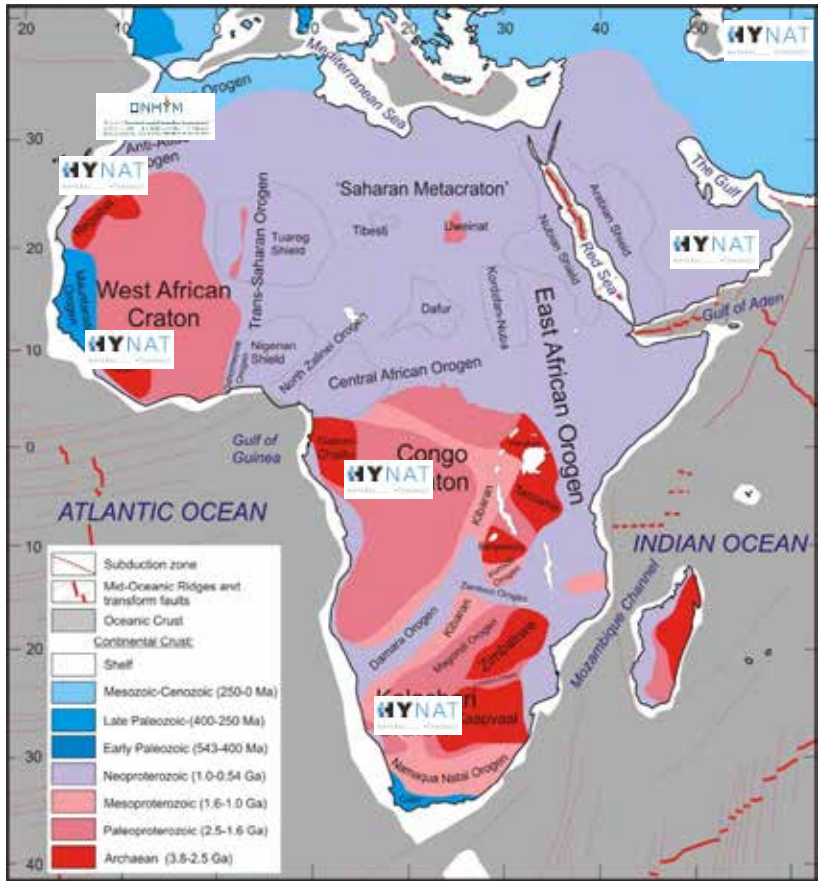


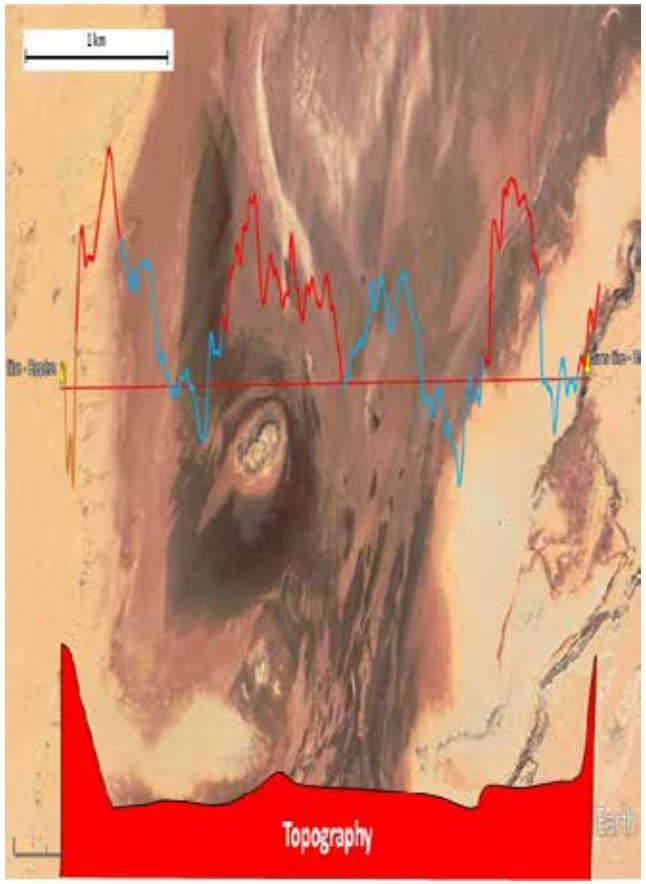
Helium and hydrogen concentrations

Noble gases isotopes



NATURAL HYDROGEN EXPLORATION IN THE SOUTH OF MOROCCO





MOROCCAN CONTEXT

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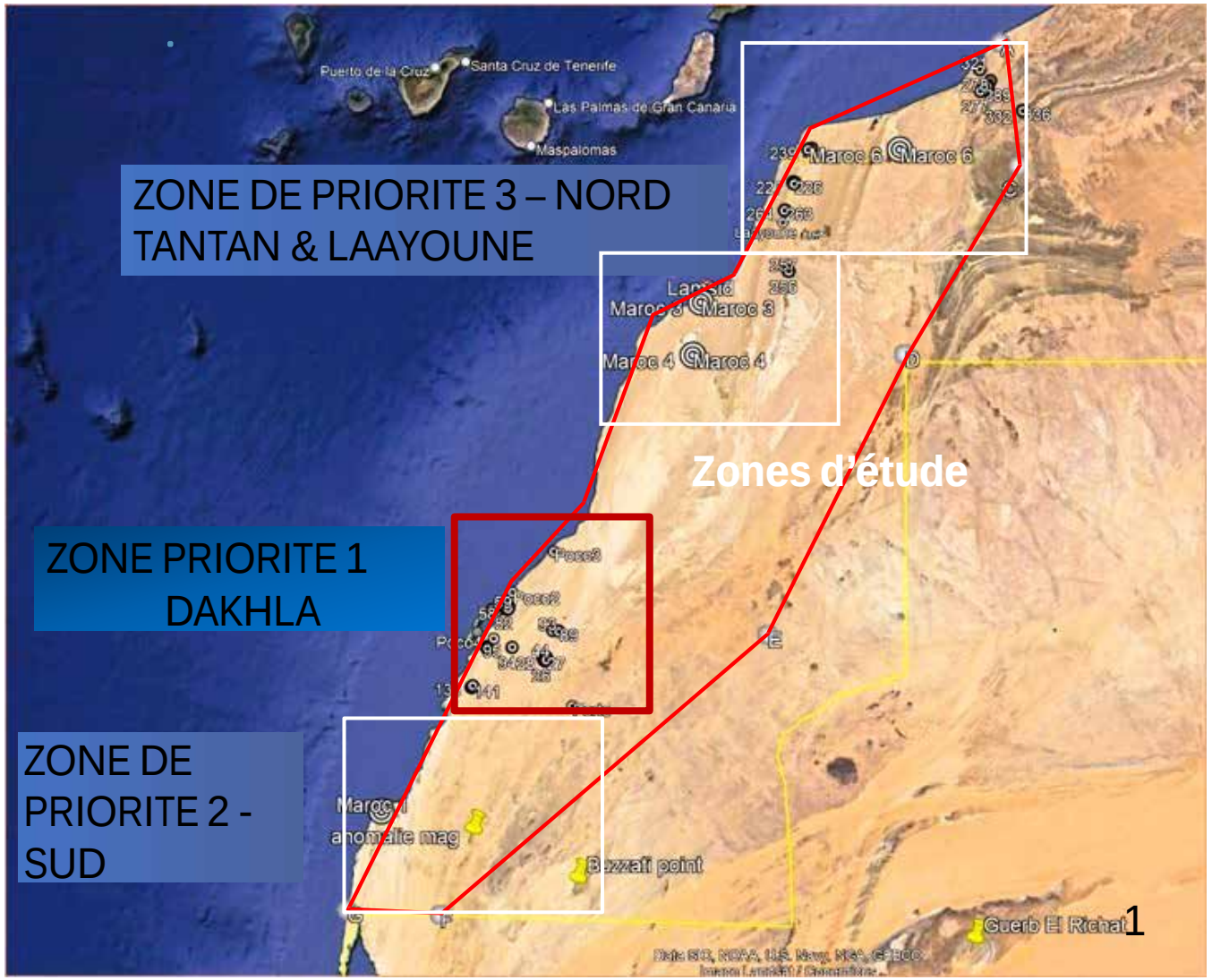
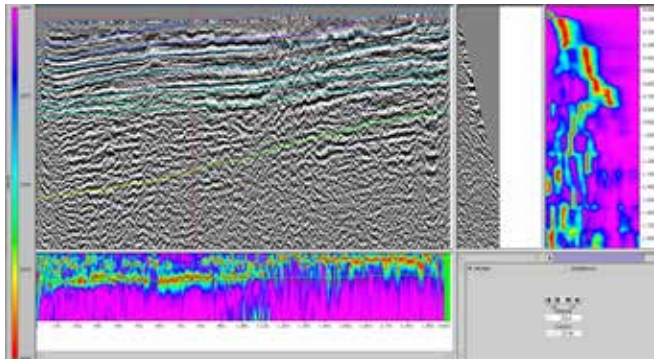
Areas where H2 presence in subsurface has been already proven (from Prinzhofer et Devilleand Moretti)

- ONHYM puts natural hydrogen as a new lever at the heart of Morocco's the energy transition strategy and also to contribute to the energetic MIX.
- In 2021, ONHYM and HYNAT signed exclusive contract in order to develop the natural H2 potential in the southern Provinces of Morocco



THE PROGRAM IN MOROCCO



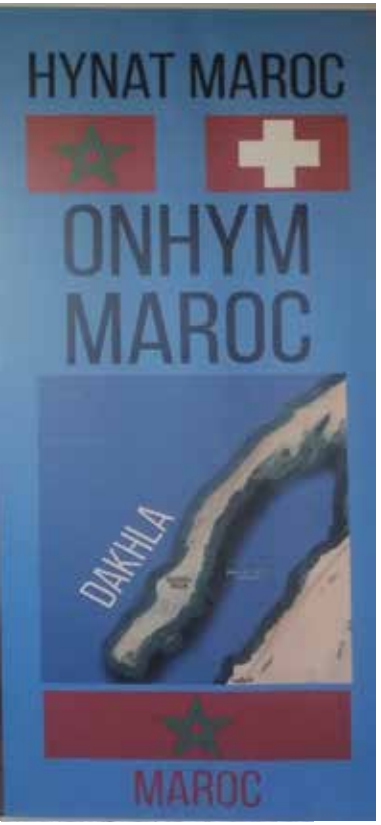
FIELD EXPLORATION	GEOPHYSICAL WORKS	FIRST DRILLING & TESTING	DRILLING CAMPAIGN & PRODUCTION
✓ Discovery of active hydrogen systems. Geoscientific data processing; Field and laboratory work; ✓ Selection of priority drilling areas	✓ Geophysics campaign ✓ Monitoring ✓ Drilling decision	✓ First drilling campaign ✓ Testing & monitoring ✓ Start of industrial project	✓ OffTake contracts ✓ Start of Production

TODAY

2021 2023 2024 2025 2026

HYNAT Maroc SA
a joint operating company with ONHYM in charge of exploiting natural hydrogen deposits in Morocco's southern provinces.

THANK YOU FOR YOUR ATTENTION



- Responding to the Royal Hydrogen Strategy.
- 93 wells by 2028.
- 100 to 2,000 meters deep.
- Productivity modeling exceeds expectations.
- Attractive and profitable volumes for Offtakers.
- Upgrading of rare gases (He,...) and carbon credits.

Natural Hydrogen in 2028